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Even more paradoxical: *Paradoxa paradoxa* sp. n. (Diptera: Mycetophilidae) from South Africa, closest relative of the New Zealand *Paradoxa fusca* Marshall

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ABSTRACT

A new species of fungus gnats (Mycetophilidae), *Paradoxa paradoxa* sp. n., is described from KwaZulu-Natal, South Africa. It is the second species of its genus beside *Paradoxa fusca* Marshall extant in New Zealand. Among southern hemisphere Mycetophilidae, *Paradoxa* is a further example of Gondwanan origin and the first one demonstrating direct affinities between the faunas of South Africa and New Zealand.

KEY WORDS: Diptera, Mycetophilidae, *Paradoxa*, fungus gnats, new species, South Africa, Gondwanan element.

INTRODUCTION

Paradoxa, the peculiar one, appeared to Marshall to be the appropriate name for a new genus described in 1896 for a single male fungus gnat specimen collected in the South Island of New Zealand. No doubt it was the peculiar wing venation of this mycetophilid that inspired the naming, as it was its almost black-coloured body that determined the species epithet, *fusca*. Another single specimen, this time a female found to be conspecific with the male, made it possible for Tonnoir and Edwards (1927) to supplement the species description. Nothing more has been published on *Paradoxa fusca* since then, however a broader study of *Paradoxa* and other New Zealand genera of the Leiinae (Mycetophilidae) is in preparation. Occurrence of *Paradoxa* in South Africa became known to the author a few years ago, when a male specimen collected in KwaZulu-Natal was identified by Uwe Kallweit, Dresden, as belonging to a species closely related to *fusca*. Among fungus gnats collected recently in KwaZulu-Natal, the author identified both males and females of this species. It is described in this paper, and named *Paradoxa paradoxa* sp. n. The unusual morphology and biogeography of *Paradoxa*, as it has become apparent through the discovery of this second species, is discussed.

MATERIAL AND METHODS

Most specimens studied were collected by aspirator, sweepnet and Malaise traps in 2005; two other specimens came from Malaise trap material collected by W. Barkemeyer in 2000. All type specimens, as well as some other specimens, were mounted on microscope slides in Canada balsam after maceration in warm 10% KOH, stepwise dehydration in ethanol, brief treatment with an ethanol/formaldehyde mixture, and treatment with beechwood creosote over several hours. Other specimens are kept in 70% ethanol. All types and most non-type specimens are deposited in the Natal Museum, Pietermaritzburg, South Africa; some voucher specimens are deposited in the Museum für Tierkunde, Dresden, Germany. From the latter institution I borrowed study material of the New Zealand *Paradoxa fusca*. For light microscope study and the preparation of drawings I used an Olympus BX50 microscope in combination with the U-DA drawing unit. Usage of morphological terminology follows Søli (1997).

TAXONOMY

Genus *Paradoxa* Marshall, 1896

Paradoxa paradoxa sp. n.

Figs 1–9

Etymology: L. *paradoxus* (peculiar).

Diagnosis: Comparatively small-sized, almost black fungus gnat with smoky-greyish wings. Among South African mycetophilids, the very presence of the cell formed through junction of A1 and CuA2 is diagnostic. Distinguished from *Paradoxa fusca* (characters of which appear below in parentheses) by having wing membrane not darkened along anterior margin, and with a few setae scattered along posterior margin (darkened and without setae); basalmost portion of M1 very weak or evanescent, and M2 distinct throughout (M1 distinct throughout, and basalmost portion of M2 very weak or evanescent); and A2 present (A2 absent). Further differences concern terminalia of both male and female.

Description:

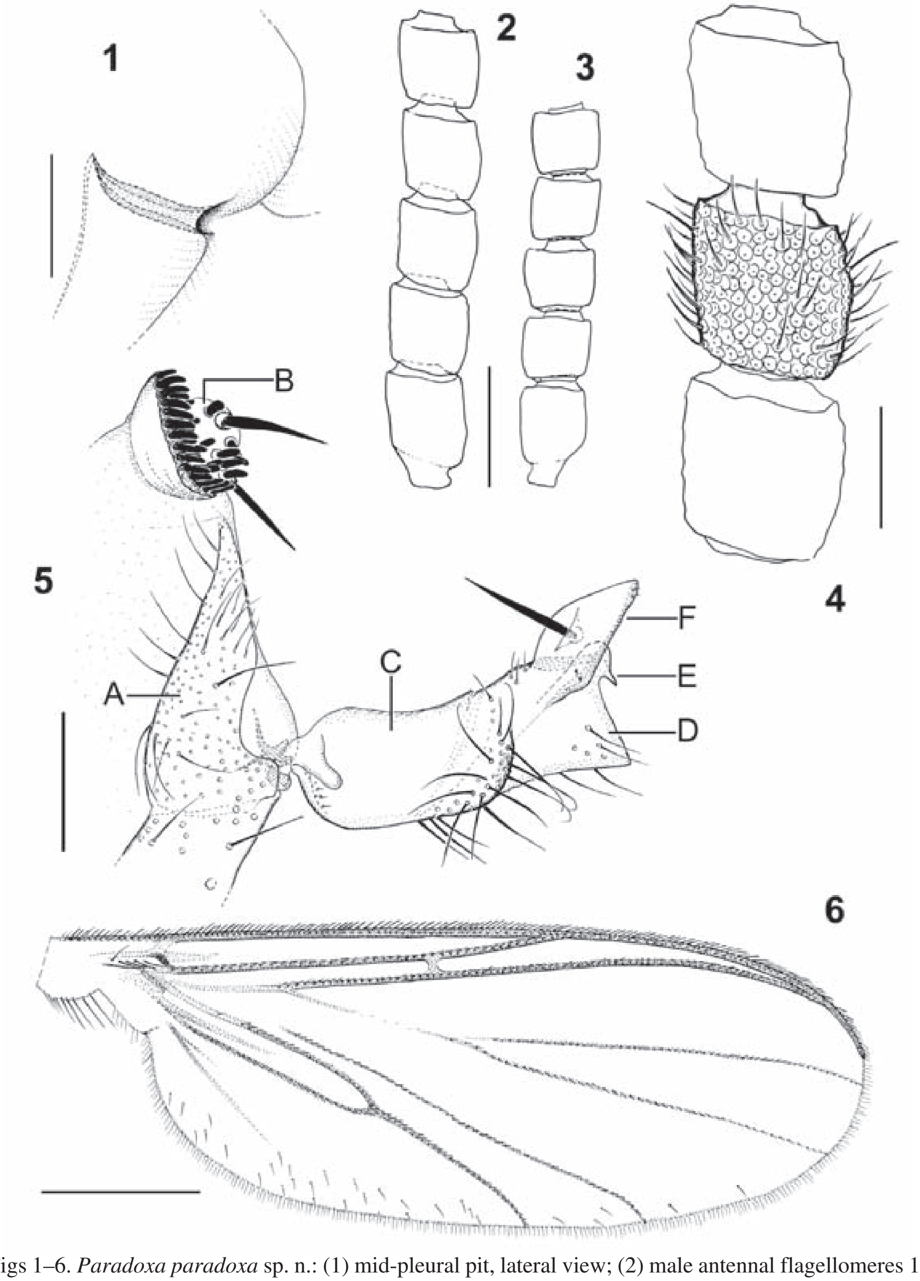
Male.

Body size 3.2–3.4 mm.

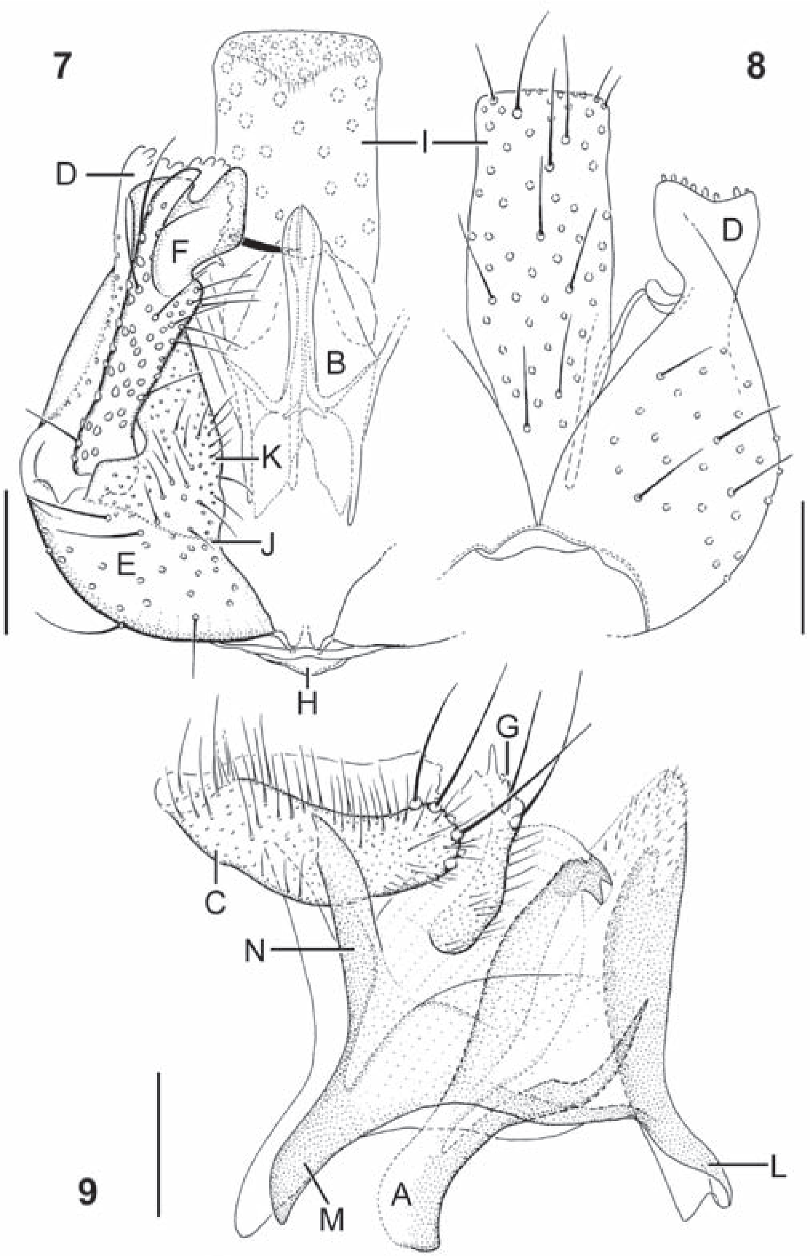
Head: Median convexity of postgenae large and well sclerotised. Medial portion of frontal furrow evanescent. Frontal tubercle small, one-pointed. Prefrons not discernible. Clypeus a little larger than face. Nodes of antennal flagellomeres 1.1 times as long as wide (Figs 2, 4); apart from short trichia, with 1–3 short setae distally (Fig. 4). Maxillary palpus with 5 segments, including two segments basally of the third; fifth segment up to 2.5 times as long as fourth segment. Labellum very large.

Thorax: Mid-pleural pit well developed (Fig. 1). *Wing* (Fig. 6): Membrane smoky-greyish, not darkened on anterior margin. C extending almost to apex of wing. R1 variable in length, but always shorter than *ta*. M-stem weak, sometimes hardly discernible; basalmost portion of M1 very weak or evanescent. A2 present, usually slightly furcate apparently due to a fold between A1 and A2. *Tb* pale and non-setose. *Legs*: Coxae light. Hind tibia with apical comb of pale setae.

Terminalia: In all specimens seen, rotated 90–180°. Sternite 9 present as bare, sclerotised beam interconnecting gonocoxites ventro-basally (Fig. 7). Tergite 9 very long, projecting markedly beyond gonocoxites, subrectangular; outside with large setae, inside with subtriangular patch of trichia apically (Figs 7, 8). Gonocoxites with a wide emargination ventrally, ventral surface bulging, forming transverse ridge; in either half with two lobes holding gonostylus; ventral lobe elongate, pointed at apex, with innumerable fine setae; dorsal lobe blunt-ending, inside with numerous small blunt megasetae and 2 large pointed megasetae (Figs 5, 7, 8). Gonostylus elongate, bearing large setae on outer surface; apically three-lobed, with ventral lobe setose, medial lobe small and hook-shaped, and dorsal lobe subrectangular and bearing 1 large megaseta pointing



Figs 1–6. *Paradoxa paradoxa* sp. n.: (1) mid-pleural pit, lateral view; (2) male antennal flagellomeres 1–5, lateral view; (3) female antennal flagellomeres 1–5, lateral view; (4) male antennal flagellomeres 3–5, lateral view; (5) distal portion of gonocoxite and gonostylus, gonostylus clasping ventrolaterally, ventral view; (6) wing. Abbreviations: A – ventral lobe of gonocoxite; B – dorsal lobe of gonocoxite; C – gonostylus; D – ventro-apical lobe of gonostylus; E – medio-apical lobe of gonostylus; F – dorso-apical lobe of gonostylus. Scale bar = 0.05 mm (Figs 1 and 4), 0.1 mm (Figs 2, 3 and 5), and 0.5 mm (Fig. 6).



Figs 7–9. *Paradoxa paradoxa* sp. n.: (7) male terminalia, ventral view; (8) male terminalia, dorsal view; (9) aedeagal complex and associated structures, lateral view. Abbreviations: A – ejaculatory apodeme; B – aedeagal complex; C – cercus; D – dorsal lobe of gonocoxite; E – gonocoxite; F – gonostylus; G – hypoproct; H – sternite 9; I – tergite 9; J – transverse ridge on gonocoxite; K – ventral lobe of gonocoxite; L – parameral apodeme; M – anterior portion of gonocoxal apodeme; N – posterior portion of gonocoxal apodeme. Scale bar = 0.05 mm (Fig. 9) and 0.1 mm (Figs 7 and 8).

dorsally (Figs 5, 7). Aedeagal complex largely membranous, with small sclerotised portions including long ejaculatory apodeme (Figs 7, 9). Hypoproct weak, its apical margin truncate, bearing large setae (Fig. 9). Lobes of cerci in markedly horizontal position, partially enclosing aedeagus laterally, with large setae pointing ventrally and very large trichia (Fig. 9).

Female.

Body size 3.5 mm.

Head: Antennal flagellomeres with nodes 0.9 times as long as wide (Fig. 3).

Terminalia: In between tergite 10 and sternite 10 a membranous portion. Proximal segment of cercus a little longer than distal segment.

Holotype: ♂ (on slide). SOUTH AFRICA: *KwaZulu-Natal*: Northern Drakensberg, Royal Natal Nat. Park, Gudu Forest (28°40.9'S:28°55.8'E), alt. 1680–1730 m, in old-growth indigenous forest, 28.xi–13.xii.2005, Malaise trap, M. Mostovski, M. & C. Jaschhof.

Paratypes: 4 ♂ 6 ♀ (all on slides): same data as holotype.

Other material examined: SOUTH AFRICA: *KwaZulu-Natal*: 3 ♂ (2 male terminalia dissected on slide, 1 in ethanol), 3 ♀ (in ethanol), same data as the types; 9 ♂ (in ethanol), same locality but 28–29.xi.2005, by aspirator, M. Jaschhof; 1 ♂ (in ethanol), same locality but 8.xii.2005, by sweepnet, M. Jaschhof; 2 ♂ (in ethanol), Northern Drakensberg, Royal Natal Nat. Park, 1.5 km S The Grotto (28°40'S:28°55'E), alt. 1750 m, in old-growth indigenous forest, 1.xii.2005, by aspirator, M. Jaschhof; 5 ♂ 6 ♀ (all in ethanol), Central Drakensberg, Cathedral Peak Nat. Res., Rainbow Gorge (28°57.6'S:29°13.6'E), alt. 1500 m, in old-growth indigenous forest, 3–15.xii.2005, Malaise trap, M. Mostovski, M. & C. Jaschhof; 8 ♂ (in ethanol), same locality but 4.xii.2005, by sweepnet, M. Jaschhof; 1 ♀ (in ethanol), Howick distr., Karkloof Range, Geekie's Farm (29°16'S:30°21'E), 29.ii–9.iii.2000, Malaise trap, W. Barkemeyer; 1 ♂ (on slide), same locality but 19–29.xi.2000; 1 ♂, Karkloof Nat. Res. (29°19.1'S:30°15.5'E), alt. 1325 m, in mistbelt forest, 26.vii–28.ix.2005, Malaise trap, M. Mostovski.

Distribution and Phenology: This species was found in the Drakensberg Mountains and Karkloof Range, both in KwaZulu-Natal. Collection sites were located in patches of indigenous, afromontane forest with yellowwood *Podocarpus* sp. at or above 1500 m altitude, and in the mistbelt forest zone at 1300 m. Most specimens were captured at the beginning of the summer rains from late November to mid December; two other specimens were collected in February/March and July/September, respectively. Preimaginal stages and larval habitat of *P. paradoxa* remain unknown.

DISCUSSION

Classification of *P. paradoxa* and *P. fusca* in one and the same genus is based on the largely corresponding derived pattern of wing veins and construction of male terminalia, and identical thorax structure. There is no autapomorphous character that could formally justify the monophyly of *Paradoxa*; instead, its derived characters are shared with other Leiinae presumed to be its closest relatives, the Neotropical *Procycloneura* Edwards in particular.

Wing venation plays a most significant role in diagnosing genera of the Leiinae, and Mycetophilidae in general. In the two *Paradoxa* species it is basically identical (short Sc, outline of M and CuA1, presence of a cell formed by CuA2 and A1), yet distinct from the other genera making the *Cycloneura* Marshall group. The two *Paradoxa* species differ in the length of C and setosity of *tb*, and in further details referred to in the Diagnosis. Talking of differences, the median convexity of postgenae is well sclerotised in *paradoxa* while not traceable in *fusca*; the frontal furrow is incomplete in *paradoxa* (vs. complete); the prefrons is not discernible (vs. distinct); the clypeus is a little larger than the face (vs. smaller than the face); male antennal flagellomeres are a little longer than wide (vs. clearly shorter than wide); the maxillary palpus is five-segmented (vs. four-segmented); the labellum is enlarged (vs. not enlarged); and the hind tibia is bearing an apical comb of pale setae (vs. such a comb missing). To some students these numerous differences might appear sufficient in order to claim separate generic status for *paradoxa* and *fusca*. However, here they are lumped together, giving emphasis to the fact that there is such a wide morphological gap between *paradoxa* + *fusca*, on the one hand, and the rest of the *Cycloneura* group, on the other hand.

Reflections on the proper rank for the new taxon should also take into consideration the palaeogeographic situation. The two lineages, *paradoxa* and *fusca*, should have been separated in the late Jurassic/early Cretaceous some 155–130 million years ago, when stretches of an ocean opened up between southern Africa and Antarctica + New Zealand, and southern Africa and South America + Antarctica (Cracraft 1975; Owen 1981; Smith *et al.* 1994). In the light of such vast temporal dimensions, the extent of morphological similarity between *paradoxa* and *fusca* is very remarkable. Direct affinities between Gondwanan components in the Diptera faunas of South Africa and New Zealand appear to be extremely exceptional, even more so on the level of sister-species. Hennig (1960) did not refer to any such case. According to Brundin (1975), in several subfamilies of the Chironomidae the respective southern African group is sistergroup of a clade comprising all the relatives from the rest of Gondwana, and all groups of New Zealand—as well as of Australia/Tasmania—have their closest relatives in South America. This pattern he considers 'strong indication … that direct connections have existed between (southern) Africa and the other southern lands, but that these connections have been cut very early' (Brundin 1975: 23). In Mycetophilidae, several previous authors recognised an old transantarctic element inherent in the faunas of southern South America, Australia and New Zealand (Freeman 1951; Colless 1970; Munroe 1974; Matile 1989), while any affinities to the South African fauna were not determined, partly due to the fact that South African fungus gnats had remained hitherto practically unknown. A brief look at the South African fungus gnats I have on hand does not reveal any further indication of direct faunal connections between South Africa and New Zealand. In terms of current knowledge, the closest relative of *Paradoxa* is *Procycloneura*, a well-defined genus with four named and several unnamed species occurring in the Neotropics between latitudes 10° and 40° S (pers. observ.), which is further evidence of the southern origin of *Paradoxa*.

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